An adaptive block tangential method for MIMO dynamical systems

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Large-scale simulations play a crucial role in the study of a great variety of complex physical phenomena, leading to very large demands on computational resources. Our aim is to produce reduced-order models that lead for faster and cheaper simulations, with accurately approximating the behaviour of the original model. The presence of multiple inputs and outputs (MIMO systems), makes the reduction process more difficult. In this work, a tangential block Arnoldi algorithm is proposed and applied for MIMO systems. This method involves construction of a reduced-order model whose transfer function interpolates that of the original one at selected interpolation points and tangent block directions. We use direct projection of the problem onto a tangential Krylov subspace of significantly smaller dimension. $\mathcal{V}_m = Range\{(\sigma_1 I_n - A)^{-1}BR_1, ..., (\sigma_m I_n - A)^{-1}BR_m\}$, where $\sigma = \{\sigma_i\}_{i=1}^m$ and $R = \{R_i\}_{i=1}^m$ are a set of a selected interpolation points and tangential matrix directions respectively [2]. Algebraic properties of the proposed algorithm are given. An adaptive way to treat multiple inputs, by dynamically choosing the next direction matrix to expand the space is also introduced. Finally, numerical experiments are reported to show the effectiveness of the proposed adaptive tangential block Arnoldi process.

Références

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